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Value of quantitative radionuclide bone scanning in the diagnosis of sacroiliac joint syndrome in 32 patients with low back pain

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Abstract A prospective study was performed to compare the results of quantitative radionuclide bone scanning with those of sacroiliac joint anesthetic block in patients with unilateral low back pain. Thirty-four subjects, forming the control group, underwent quantitative radionuclide bone scanning of the sacroiliac joints. The normal values in sacroiliac uptake difference were taken to be between –1.7% and +6.2%. Thirty-two patients with chronic unilateral low back pain underwent sacroiliac bone scanning and sacroiliac joint block. Six of the seven patients with increased uptake > 6.2% on the painful side had at least 75% pain reduction in response to the block. The sensitivity, specificity, and positive and negative predictive values of the quantitative bone scanning in the unilateral mechanical sacroiliac joint syndrome were 46.1%, 89.5%, 85.7%, and 72%, respectively.

Key words Low back pain · Sacroiliac joint · Bone scan

Introduction

Low back pain may stem from a large number of different causes. In the majority of cases, the condition may be traced to the intervertebral disc or the facet joints [12]. However, in almost 50% of cases the most thoroughgoing investigations fail to reveal a cause [9]. One source of low back pain may be the sacroiliac (SI) joint. Until recently, this was a purely speculative assumption. Now, there are studies that lend support to this view. Anesthetic block of the joint has been shown to provide almost complete pain relief in 15%–20% of patients suffering from chronic unilateral low back pain [7, 11].

Attempts have also been made to establish clinical manifestations and SI joint examination maneuvers that would have positive predictive value. This search has not been productive. Pain has been found to be distributed along the SI joint line [4, 5] and occasionally to radiate into the groin [11]. However, these patterns are by no means pathognomonic, since pain arising in the discs or in the facet joints may show the same pattern. Similarly, none of the SI joint maneuvers studied (whether tests for restriction of joint mobility or pain provocation tests) has been found to possess significant predictive value, either by itself of combined with other tests [7, 11]. Imaging the joint after injection of a dye is equally uninformative [7, 11]. In the absence of more conclusive tests, the diagnosis of SI joint syndrome is currently made on the strength of a single or double SI joint block. This technique carries a slight risk of iatrogenic infection (less than 0.01%, according to Newberg et al. [8]) and needs to be performed by a skilled radiologist.

Bone scans are the procedure of choice for demonstrating stress fractures, infection, or inflammation involving the SI joint [9]. They also provide information on bone repair and increased bone remodeling due to altered weight bearing, and on the presence of an acute, inflammatory episode of an osteoarthritic lesion. Quantitative bone scanning allows comparison of the SI uptake, the sacrum being used as a reference point [3], and has been used in ankylosing spondylitis and in Reiter's disease [9]. Bernard and Cassidy [1] feel that "quantitative bone scan could be an important objective test for diagnosing sacroiliac joint syndrome".

We therefore decided to perform a prospective evaluation of quantitative radionuclide bone scanning in patients

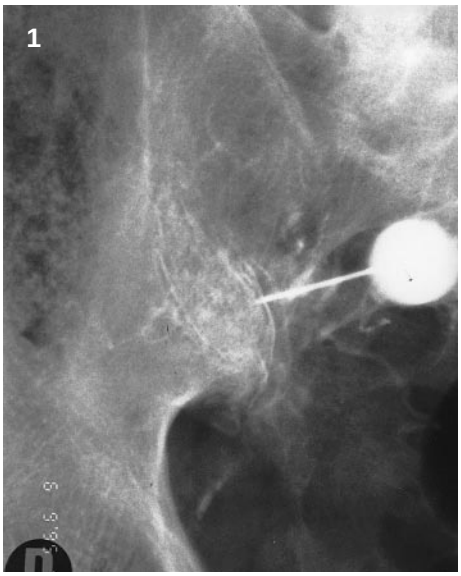

Fig. 1 Characteristic sacroiliac arthrogram. In cases when this image was not obtained because of technical difficulties, the patient was withdrawn from the study

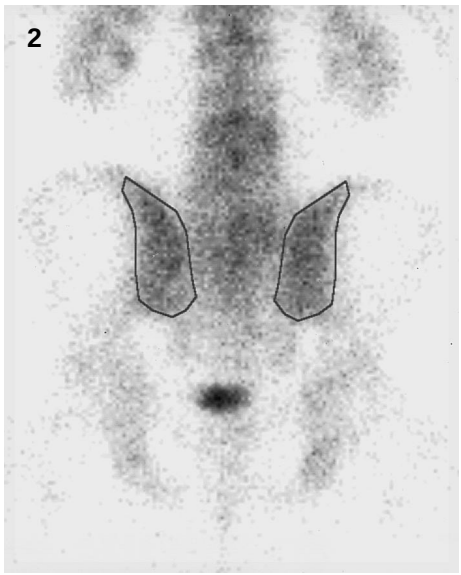

Fig. 2 Delineation of regions of interest on a sacroiliac bone scan

with low back pain, in order to establish the positive predictive value of unilateral increased radionuclide uptake by the SI joint.

Patients and methods

Control group

As a first step, a control group was set up. This group was made up of patients who had never suffered from conditions involving the lumbar spine, and who had been referred to the nuclear medicine department for investigation of pain involving the cervical spine, thoracic spine, or the upper limbs. Three hours after the intravenous injection of 525 MBq Tc-99m-labelled hydroxymethylene diphosphonate, and following the body scan required for the workup of the patients, posterior and anterior regional images of the SI joints were acquired with the patient supine, using a gamma camera (Helix, Elscint, Israel) with a high resolution parallel collimator. Six hundred Kcounts per image were achieved using a 256 × 256 matrix.

Regions of interest were drawn symmetrically around the SI joints on the posterior view. The posterior view was chosen in the light of the data in the literature, in order to avoid attenuation of radiation by the pelvic organs and because the regions of interest are easier to select on this view [2]. The area chosen included the entire dorsal aspect of the SI joint, in order to eliminate effects from inhomogeneous tracer distribution (Fig. 1). A background subtraction of 8% was performed in order to increase the contrast achieved between the SI joints and the other structures. The results were reported as percentages (plus or minus) of difference in uptake between the right and the left side, without considering the uptake of the sacrum, since, for the workup of patients with unilateral pain, it was felt that a direct comparison of the two SI joints was the more logical approach.

Patient group

The patients enrolled in the study were chronic low back pain sufferers who had presented to our hospital. Patients under the age of 18 and those with a history of surgery or lumbar disc chemonucleolysis were not eligible; neither were pregnant women. All the patients had been suffering for over 7 weeks from a pain pattern compatible with an SI pain source (unilateral low back pain, with or without irradiation into the back of the thigh). Tenderness (pain on palpation) of the SI joint line was a condition for inclusion in the study. Pain (as opposed to tenderness) was rated by means of a 10-cm visual analog scale (VAS); the minimum rating required was 4 cm. It was further required that marked lumbar disc narrowing (with > 50% loss of disc space), spondylolisthesis, herniated intervertebral disc, and spinal stenosis should have been ruled out by standard radiographs and CT scans. These criteria were imposed in order to enhance the probability of the pain reported by the patients being sacroiliac in origin.

The patients first underwent a quantitative radionuclide bone scan to study the uptake by the SI joints. The protocol used was similar to that employed in the control group, but only posterior images of the pelvis and the lumbar spine were obtained. The observer was blinded to the painful side.

Between 1 day and 14 days later, an SI anesthetic block was applied under fluoroscopic guidance. The joint space was entered in its most caudal part, with the patient lying in a prone position. The injection of 1 ml iopamidol 200 mg/ml allowed the correct position of the needle inside the joint to be checked (Fig. 2). Thereafter, approx. 2 ml 2% lidocaine was injected. The patients were requested to complete two VAS, one before and the other 15 min after the block. If more than 75% pain relief was reported, the block was considered positive. If the needle was not inside the joint, the patient was eliminated from the study. The investigator was blinded to the results of the bone scan.

Patient data

In the control group, there were 34 subjects (18 male, 16 female); the mean age was 52.4 ± 14.7 years (range: 18–70 years). In the patient group, 39 radionuclide scans were performed; however, in only 32 cases was the SI block applied strictly intra-articularly. The study, therefore, included only these 32 patients. There were 14 male and 18 female patients, whose mean age was 53.4 ± 18.5 years (range: 24–86 years). The two groups were well matched for age ($P = 0.82$) and for sex ($P = 0.49$). In 22 cases, the low back pain was on the right; in 8 cases, it was on the left ($\chi^2 = 3.90$, $P < 0.05$).

The 7 patients in whom a technically correct SI arthrogram was not obtained were not given an anesthetic block. They only received periarticular steroid treatment.

Statistical methods

Categorical variables were compared using a χ^2 test. Since the distribution of the radionuclide uptake between the two sides was not known, we used the Wilcoxon test for paired data, and the Mann-Whitney (two-sample) or Kruskal-Wallis (three or more sample) tests for non-paired data. The upper and lower tenth percentiles of the distribution in the control group were arbitrarily taken as thresholds for defining abnormality in the patient group. A *P* value of less than 0.05 was considered significant.

Results

Control group

In the control group, the mean asymmetry of uptake was +1.7% ± 4.1% (range: –10.4% to +10.6%) in favor of the right-hand side; in other words, the right-hand side had a 1.7% higher uptake than did the left. By convention, normal values were taken to be between –1.7% (lower tenth percentile) and +6.2% (upper tenth percentile).

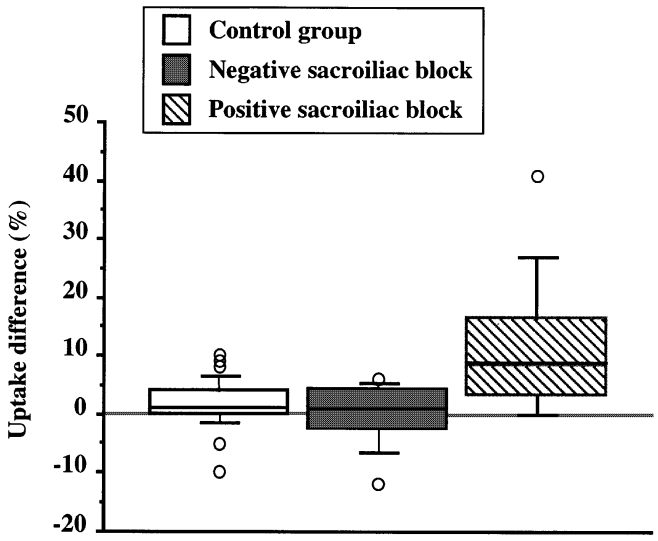

Fig. 3 Box-plot graph representing the differences in distribution of uptake in the three groups of patients. The *line* in each box is the median. The *upper* and *lower limits* of the box are the 75th and the 25th percentile of the distribution. The *bars* outside the box are the 90th and the 10th percentile of the distribution

Patient group

In the patient group, the mean asymmetry of uptake was +5.3% ± 10.3% (range: –4.6% to +41%) in favor of the painful side. There was no significant difference as compared with the control group ($P = 0.16$ in the Wilcoxon test). Twenty patients showed symmetrical uptake. Five had contralateral increased uptake while seven had increased uptake on the painful side.

Thirteen patients had a positive block (40.6%) and were considered to have pain of SI origin. The painful SI joint had an uptake that was 11.6% ± 11.6% higher than that observed on the contralateral side. Nineteen patients had a negative block (59.3%). The asymmetry was only 0.007% ± 4.9% (Fig. 3). The comparison of these two subgroups with the control group showed a significant difference ($P = 0.0015$ in the Kruskal-Wallis test) (Fig. 3). Equally, there was a significant difference when the "block-positive" patients were compared with the control group ($P = 0.006$) and with the "block-negative" patients ($P = 0.002$). There was no statistically significant difference between the "block-negative" patients and the controls ($P = 0.09$). Table 1 shows that six out of the seven patients with increased uptake on the painful side had a positive anesthetic block. This pattern was not observed in any of the patients with contralateral increased uptake; it was seen in only 7 of 20 (35%) with symmetrical uptake. In this latter group, the SI-joint-to-mid-sacrum uptake ratio was close to 1 (1.05 ± 0.08), which suggests that uptake was not increased bilaterally.

If we consider that SI radionuclide scans are positive if uptake on the painful side is more than 6.2% as compared to the other side, their sensitivity in identifying the SI joint as the source of lower back pain is 46.1%; the specificity is 89.5%, the positive predictive value 85.7%, and the negative predictive value 72%.

Table 1 Relationship between sacroiliac anesthetic block results and radionuclide uptake patterns

	Increased uptake on painfree side	Symmetrical uptake[a]	Increased uptake on painful side	Total
No. of patients	5	20	7	32
Age in years (mean ± SD)	53.8 ± 15.9*	49.5 ± 19.1*	58.4 ± 13.8*	53.4 ± 18.5
No with positive block	0	7	6	13
Age in years (mean ± SD)				51.3 ± 18.5
No. with negative block	5	13	1	19
Age in years (mean ± SD)				51.9 ± 19

[a] Right/left uptake difference between –1.7 and +6.2%
* $P = 0.52$

Discussion

Sacroiliac anesthetic block is the "gold standard" in the diagnosis of mechanical SI pain syndromes [6]. In an earlier study, Slipman et al. compared the results of radionuclide scans with those of an anesthetic block in 20 low back pain patients in whom an SI syndrome was suspected [13]. The study involved a comparison of the two sides. No attempt at quantitation was made, neither was there a control group. The results obtained by these earlier workers agree with ours as regards specificity (100% vs 89.5%). However, the sensitivity of their radionuclide scans was much lower (3 positive scans in a total of 18 patients with a positive block, against 6 of 13 in our study). By performing a quantitative analysis of uptake in a control group, we were able to establish the physiological range and to enhance the sensitivity of the technique.

The finding of increased uptake raises the question of what was causing the pain. Tracer uptake is a function of blood flow and bone matrix turnover [10]. In the SI joint, the subchondral bone is responsible for the increased uptake [14]. In our study, this phenomenon could reflect osteoarthritic lesions with or without an acute inflammatory episode. The five patients with contralateral increased uptake (all block-negative) may have had asymptomatic contralateral osteoarthritis, or they may have been patients with degenerative lumbar spondylosis, in whom false-positive bone scans over the SI joint region have been reported [6]. Increased bone remodeling due to altered weight bearing by the contralateral SI joint could also be considered as a cause in the case of a positive block.

This possibility of asymptomatic increased uptake in low back pain (and absence of the phenomenon in the controls) is interesting. There are patients with discogenic pain and asymptomatic increased uptake in the SI joint on the painful side – a fact that would, in theory, diminish the specificity of the technique.

Conclusions

This is the first study to use quantitative bone scanning in the diagnosis of mechanical SI joint pain syndromes. The poor sensitivity of this imaging technique militates against its routine use. On the other hand, because of their high specificity, these scans may be useful in two circumstances. Firstly, they may provide information in cases where the diagnosis of mechanical SI joint pain is likely, but where arthrography and blockade are not technically feasible. Secondly, they may be useful as a first approach to the differential diagnosis of atypical pain in the SI region. Increased radionuclide uptake in the SI joint on the painful side would suggest that the condition is due to a mechanical SI joint pain syndrome.

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